

WHAT IS CLAIMED IS:

1. An optical communication device substrate, comprising one of ceramic and glass ceramic each having an average thermal expansion coefficient of  $-55$  to  $-120 \times 10^{-7}/^{\circ}\text{C}$  in the temperature range of  $-40$  to  $+100^{\circ}\text{C}$  and each containing one of a  $\beta$ -quartz solid solution and a  $\beta$ -eucryptite solid solution as a main crystal, wherein maximum thermal expansion hysteresis that occurs when temperature rise from  $-40^{\circ}\text{C}$  to  $100^{\circ}\text{C}$  at a rate of  $1^{\circ}\text{C}/\text{min}$  and temperature lowering from  $100^{\circ}\text{C}$  to  $-40^{\circ}\text{C}$  at a rate of  $1^{\circ}\text{C}/\text{min}$  are performed is less than 12 ppm.

2. An optical communication device substrate according to claim 1, wherein a difference between a maximum value and a minimum value out of average thermal expansion coefficients calculated for each of 7 sections, the sections being obtained by dividing the temperature range of  $-40^{\circ}\text{C}$  to  $100^{\circ}\text{C}$  every  $20^{\circ}\text{C}$ , is  $6 \times 10^{-7}/^{\circ}\text{C}$  or less when the temperature is lowered from  $100^{\circ}\text{C}$  to  $-40^{\circ}\text{C}$  at a rate of  $1^{\circ}\text{C}/\text{min}$ .

3. An optical communication device substrate according to claim 1 or 2, wherein the substrate contains 45 to 60 mass%  $\text{SiO}_2$ , 20 to 45 mass%  $\text{Al}_2\text{O}_3$ , 7 to 12 mass%  $\text{Li}_2\text{O}$ , 0 to 4 mass%  $\text{TiO}_2$ , and 0 to 4 mass%  $\text{ZrO}_2$ .

4. An optical communication device substrate according to claim

3, wherein a molar ratio of  $\text{Li}_2\text{O} : \text{Al}_2\text{O}_3 : \text{SiO}_2$  is 1 : 1.5 to 2.5 : 2 to 3.

5. A method of manufacturing an optical communication device substrate, the substrate including one of ceramic and glass ceramic each having an average thermal expansion coefficient of  $-55$  to  $-120 \times 10^{-7}/^\circ\text{C}$  in the temperature range of  $-40$  to  $+100^\circ\text{C}$  and each containing one of a  $\beta$ -quartz solid solution and a  $\beta$ -eucryptite solid solution as a main crystal, the method comprising performing, on the substrate, high temperature treatment at the temperature of  $200^\circ\text{C}$  or higher and low temperature treatment at the temperature of  $20^\circ\text{C}$  or lower alternately, each of the high temperature treatment and the low temperature treatment being performed multiple times, wherein the difference between the temperature at which the high temperature treatment is performed and the temperature at which the low temperature treatment is performed is in a range of  $40$  to  $240^\circ\text{C}$ .

6. A method of manufacturing an optical communication device substrate according to claim 5, wherein low temperature treatment at the temperature of  $-40^\circ\text{C}$  or lower and high temperature treatment in the temperature range of  $20$  to  $200^\circ\text{C}$  are performed on the substrate alternately, each of the low temperature treatment and the high temperature treatment being performed multiple times.

7. A method of manufacturing an optical communication device substrate according to claim 6, wherein each of a time for one isothermal retention at the temperature of  $-40^{\circ}\text{C}$  or lower and a time for one isothermal retention in the temperature range of  $20$  to  $200^{\circ}\text{C}$  is 60 minutes or less.

8. An optical communication device obtained by fixing an optical component having a positive thermal expansion coefficient onto the optical communication device substrate according to any one of claims 1 to 4.